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*Andrew Gersey*

Dated

3 February 2003

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# Patents Form 1/77

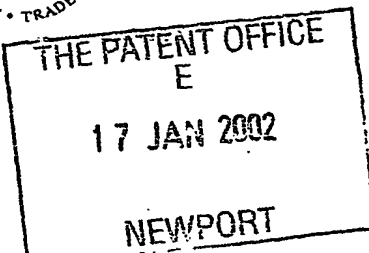
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18 JAN 02 E688907-1 D02B47  
P01/7700 0.00-0201092.4

## Request for grant of a patent

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Cardiff Road  
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1. Your reference

HL79828/000/JC

2. Patent application number

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17 JAN 2002

0201092.4

3. Full name, address and postcode of the or of each applicant (underline all surnames)

ADVANCED TRANSPORT SYSTEMS LIMITED  
Bridge House, Sion Place, Clifton  
Bristol BS8 4AP

Patents ADP number (if you know it)

08306599001

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

A DOOR

5. Name of your agent (if you have one)

Haseltine Lake & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Imperial House  
15-19 Kingsway  
London  
WC2B 6UD

Patents ADP number (if you know it)

34001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if

Yes

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
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# Patents Form 1/77

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Continuation sheets of this form -

Description 9

Claim(s) 4

Abstract 1

Drawing(s) 4 +4

10. If you are also filing any of the following, state how many against each item.

Priority documents -

Translations of priority documents -

Statement of inventorship and right to grant of a patent (Patents Form 7/77) -

Request for preliminary examination and search (Patents Form 9/77) ☒

Request for substantive examination (Patents Form 10/77) -

Any other documents (please specify) -

11.

I/We request the grant of a patent on the basis of this application.

Signature

*[Signature]*

Date

17<sup>th</sup> January 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr J R A M Cheyne

[0117] 910 3200

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A DOOR

This invention relates to a door, and is particularly, although not exclusively, concerned with a door for a vehicle.

Sliding doors for vehicles are well known, in particular for providing passenger access to road and rail passenger vehicles. On opening, such doors move linearly into cavities in the vehicle structure on one or both sides of the door aperture. There are also so-called swing plug doors which are mounted on a swinging mechanism which enables them to swing outwardly and to the side of the door aperture. Some swing plug doors also have a sliding mechanism to enable the door to slide over the outside of the vehicle structure

Doors which slide into cavities in the vehicle structure require a substantial amount of space to the side of the door aperture to accommodate the door. Such doors can therefore be used in railway vehicles, but they are inappropriate for shorter vehicles which do not have space for the cavities.

Swing plug doors do not require the vehicle structure to extend significantly beyond the door aperture unless they also incorporate a sliding mechanism for increasing the lateral displacement of the door after it has moved outwardly of the door aperture. However, swing plug doors employ a lever arrangement to support the door and control its movement, and this mechanism often encroaches substantially into the interior of the vehicle when the door is closed. Such systems are

consequently also inappropriate for use in small vehicles.

According to the present invention there is provided a  
5 door mounted on a structure for displacement between an  
open position and a closed position with respect to a  
door aperture in the structure, the door being  
connected to the structure by first guide means, which  
constrains a leading edge of the door, with respect to  
10 movement towards the open position, to execute an  
arcuate movement about an axis which is fixed with  
respect to the structure, and by second guide means,  
which constrains a trailing edge of the door to execute  
a linear movement substantially parallel to the plane  
15 of the door aperture.

The first guide means may comprise a door control lever  
which is pivotable at one end about an axis which is  
fixed with respect to the structure and which is  
20 pivotably connected at the other end to the door  
adjacent the leading edge. The axis about which the  
lever pivots may be substantially upright.

Drive means may be provided for moving the door between  
25 the open and closed positions. The drive means may be  
mounted so as to rotate the door control lever, for  
example by acting on a drive lever which projects from  
the axis and is rigidly connected to the door control  
lever.

30 In order to enhance the stability of the door, two door  
control levers may be provided. They may be fixed  
rigidly to a common shaft which defines the axis about  
which the door control levers move. The door control

levers may have the same length as each other between the common shaft and the pivotal connection with the door.

5 The second guide means may comprise a guide element which is mounted adjacent the trailing edge of the door and which is slidable along a guide track, for example in the form of a rail, which is fixed to the structure. The guide track may lie in a plane which is  
10 perpendicular to the axis of the arcuate movement controlled by the first guide means. Thus, if that axis is generally upright, the guide track will extend generally horizontally, and parallel to the plane of the door opening.

15 The second guide means may comprise two of the guide tracks, for example disposed adjacent the top and bottom of the door. The guide tracks may lie in a common plane which is inclined to the axis of arcuate  
20 movement.

The door may be curved, or otherwise shaped, so that different portions of the door lie in different planes. For example, the upper portion of the door may be  
25 displaced inwardly (with respect to the structure) relatively to the lower part of the door. For example, the door, in its upper region, may be curved about a generally horizontal axis. With such a configuration, the door may flex under the action of the first and  
30 second guide means as the door moves between the open and closed positions.

In a preferred embodiment, the structure is a vehicle body, the door being provided to provide passenger axis

to the interior of the vehicle. The vehicle body may have inner and outer skins, in which case the axis of the arcuate movement may extend between the skins and, where drive means is provided, this may also be  
5 provided between the skins. If the door is controlled by means of one or more door control levers, then at least one of these levers may extend through an opening in the outer skin in the open position of the door.

10 Similarly, where the first guide comprises upper and lower guide tracks, the upper guide track may be disposed in a channel in the outer skin. The lower guide track may be disposed below a floor of the vehicle.

15 For a better understanding of the present invention, and to show how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

20 Figure 1 shows a vehicle with doors in a closed position;

Figure 2 shows the vehicle with the doors in the open  
25 position;

Figure 3 shows the connections of the door to the mounting structure;

30 Figure 4 is a sectional view at an upper region of the door;

Figure 5 is a fragmentary view corresponding to Figure 4;

Figure 6 is a sectional view of a lower region of the door; and

- 5 Figure 7 is a fragmentary view corresponding to Figure 6.

10 The vehicle shown in Figures 1 and 2 is intended for use in urban transport systems. In such a system, a fleet of the vehicles would be available to passengers. The vehicles would be driverless, and would circulate on dedicated trackways provided with appropriate guidance means.

- 15 The vehicle comprises a main vehicle structure 2 having a door aperture 4 (preferably one on each side of the vehicle). Each aperture 4 is closed by a pair of doors 6 which can open, as shown in Figure 2, to provide access to the interior of the vehicle. As shown in
- 20 Figure 2, when in the open position, the leading edge 8 of each door (with respect to the direction of movement of the door towards the open position) is displaced outwardly of the door aperture 4 whereas the trailing edge 10 remains substantially in the plane of the door aperture 4. The doors 6 are thus able to open without
- 25 a significant outward swinging movement. Such swinging movements are undesirable in automatically operated doors, since they could bring the doors into contact with waiting passengers or objects at the side of the
- 30 vehicle. Also, the oblique positions of the doors when open provides a funnelling effect to direct passengers into the vehicle.



As shown in Figure 3, the door 6 is supported by first guide means 12 at its leading edge 8, and by second guide means 14 at its trailing edge 10. The first guide means 12 comprises an upright shaft 16 which is  
 5 supported at top and bottom by bearings (not shown) which are fixed with respect to the vehicle structure 2. Two door control levers 18 and 20 are secured rigidly to the shaft 16 adjacent its top and bottom ends. The two door control levers 18 and 20 extend  
 10 parallel to each other and are of substantially the same length as each other. Each lever 18, 20 is connected to the door 6 at a position close to the leading edge 8 by means of self-aligning bearings 22.

15 A drive lever 24 is rigidly secured to the shaft 16 at its lower end. At its end away from the shaft 16, the drive lever 24 is connected to a motor.

The second guide means 14 comprises guide tracks in the  
 20 form of rails 26 and 28 which are fixed to the vehicle structure 2 towards the top and bottom respectively of the door aperture 4. Sliders 30 and 32 respectively are mounted on the door 6 adjacent its trailing edge 10, and close to its top and bottom edges.

25

The rails 26, 28 extend parallel to the longitudinal axis of the vehicle and lie in, or close to, the plane of the door opening. The rails 26, 28 are thus parallel to each other, and lie in a common plane which  
 30 is inclined to the axis of the shaft 16. This is because the door 6 is curved, particularly at its upper end, so that the vertical planes containing the rails 26 and 28 are spaced apart from each other, with the

plane containing the rail 26 being displaced in the inboard direction of the vehicle.

The closed and open positions of the door 6 are represented respectively by the solid outline 6 and the dashed outline 6'. As the shaft 16 is rotated by the action of the motor on the drive lever 24, the door control levers 18 and 20 swing outwardly to move the leading edge 8 of the door through an arcuate path which takes it out of the plane of the door aperture 4 and longitudinally away from the door aperture. The trailing edge of the door 10, however, does not move out of the plane of the door opening 4, since it is guided by the rails 26.

Because the common plane containing the rails 26 and 28 is inclined to the axis of the shaft 16, the door 6 will flex as it moves between the open and closed positions. It is consequently necessary for the door to be constructed with sufficient flexibility to allow this flexing to occur without excessive stress on the components. If such flexing is undesirable in any particular application, control of the trailing edge 10 of the door 6 can be achieved with only a single rail 26 or 28 and slider 30 or 32.

Figures 4 and 5 show in more detail the configuration at the upper end of the trailing edge 10 of the door 6. The vehicle structure 2 comprises an outer skin 34 comprising a roof panel. At the edge of the roof panel 34 bordering the door opening 4, the roof panel 34 is extended to form a channel 36 which terminates at a seal 38.

The door 6 comprises a door frame 40 to which a glass layer 42 is bonded to provide a window. A slide mount 44 is fixed to the door frame 40 by screws 46. The slide mount 44 comprises a spigot 48 on which the slider 30 is pivotably mounted by means of bushes 50. The slider 30 is retained on the spigot 48 by means of a circlip 52. A further bush 54 is retained within the slider 30 for engagement with the rail 26.

Figures 6 and 7 show in greater detail the structure of the rail 28 and the slider 32 towards the lower end of the trailing edge 10 of the door 6. As shown in Figures 6 and 7, the vehicle structure comprises a frame 56 to which a protective beam 58 is fixed. A floor panel 60 is supported by the frame 56. A slider mounting 62 having a spigot 64 is secured to the door 6 by screws 66. The slider 32 is mounted on the spigot 64 by means of bushings 68. A bush 70 is accommodated in the slider 32 to engage the rail 28.

The rails 26 and 28 are secured to the vehicle structure by means which are not shown in the drawings.

It will be appreciated from Figures 4 to 7 that the rails 26 and 28 and the associated sliders 30 and 32 operate outside the passenger compartment of the vehicle. The channel 36 shields the upper rail 26 and slider 30 from contact by passengers in the vehicle, while the floor board 60 and the protective beam 58 similarly shields the lower rail 28 and the lower slider 32.

As can be appreciated from Figure 4, the vehicle structure comprises an outer skin 34. Although not

shown, there is also an inner skin which is situated within the outer skin and defines the passenger enclosure. The shaft 16 is disposed between the inner and outer skins, as is the drive lever 24 and the motor connected to it. An opening, for example in the form of a slot, is provided in the outer skin 34 along which each door control lever 18, 20 moves as the door opens. The mechanism associated with the shaft 16 is thus shielded from the passenger compartment.

CLAIMS

1. A door mounted on a structure for displacement  
between an open position and a closed position  
5 with respect to a door aperture in the structure,  
the door being connected to the structure by first  
guide means, which constrains a leading edge of  
the door, with respect to movement towards the  
open position, to execute an arcuate movement  
10 about an axis which is fixed to the structure, and  
by second guide means, which constrains a trailing  
edge of the door to execute a linear movement  
substantially parallel to the plane of the door  
aperture.
- 15 2. A door as claimed in claim 1, in which the first  
guide means comprises a door control lever which  
is mounted at one end for pivoting movement about  
an axis fixed to the structure, and is connected  
20 at the other end for pivotable movement relative  
to the door.
3. A door as claimed in claim 1 or 2, in which the  
axis of arcuate movement is upright.
- 25 4. A door as claimed in claim 2 or 3, in which drive  
means is provided for pivoting the door control  
lever relatively to the structure.
- 30 5. A door as claimed in claim 4, in which the drive  
means acts on a drive lever which is rigidly  
connected to the door control lever.

6. A door as claimed in any one of claims 2 to 5, in which the door control lever is one of two door control levers which are rigidly mounted on a common shaft which is rotatable about the axis.
- 5 7. A door as claimed in claim 6, in which the door control levers are connected to the door at the same perpendicular distance as each other from the axis.
- 10 8. A door as claimed in any one of the preceding claims, in which the second guide means comprises a guide element mounted adjacent the trailing edge of the door, the guide element engaging a guide track which is fixed to the structure.
- 15 9. A door as claimed in claim 8, in which the guide track extends parallel to the plane of the door opening.
- 20 10. A door as claimed in claim 8 or 9, in which the guide track lies in a plane which is perpendicular to the axis of arcuate movement.
- 25 11. A door as claimed in any one of claims 8 to 10, in which the guide track is one of two parallel guide tracks which are spaced apart in the direction of the axis of arcuate movement.
- 30 12. A door as claimed in claim 11, in which the guide tracks lie in a common plane which is inclined to the axis of arcuate movement.

13. A door as claimed in any one of the preceding claims, in which the door is curved about a generally horizontal axis.
- 5 14. A door as claimed in any one of the preceding claim, in which the structure is a vehicle body having inner and outer skins.
- 10 15. A door as claimed in claim 14, in which the axis of arcuate movement extends between the skins.
16. A door as claimed in claim 14 when appendant to claim 4, in which the drive means is disposed between the skins.
- 15 17. A door as claimed in claim 16, in which the or each drive control lever projects through the outer skin of the vehicle body when the door is in the open position.
- 20 18. A door as claimed in any one of claims 14 to 17 when appendant to claim 8, in which the guide track, or one of the guide tracks, is disposed in a channel formed in the outer skin.
- 25 19. A door as claimed in any one of claims 14 to 17 when appendant to claim 8, in which the guide track, or one of the guide tracks, is disposed below a floor panel which is secured to the
- 30 20. A door mounted on a structure substantially as claimed in herein with reference to, and as shown in, the accompanying drawings.

21. A vehicle having a door in accordance with any one of the preceding claims.



ABSTRACTA DOOR

A door 6, for example in a vehicle, is mounted at one  
5 edge 8 for arcuate movement about the axis of a shaft  
16, and at the other edge 10 for displacement  
substantially in the plane of the door opening along  
rails 26, 28. Thus, on opening, the edge 8 swings  
outwards from the door opening before moving  
10 longitudinally away from the door opening, with the  
edge 10 being guided along the rails 26 and 28.

1/4

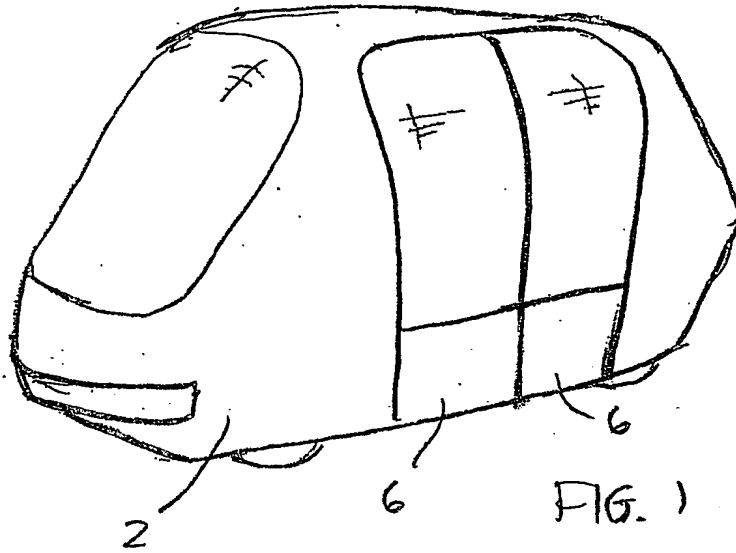


FIG. 1

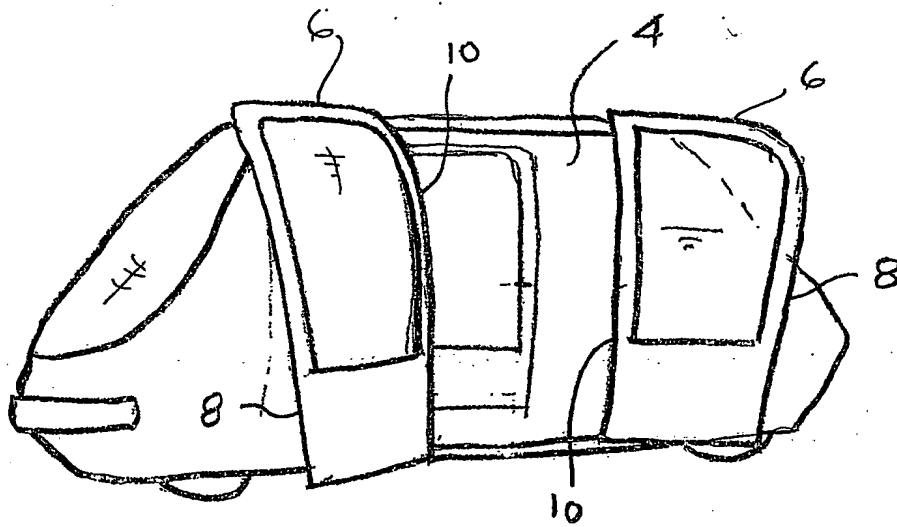


FIG. 2

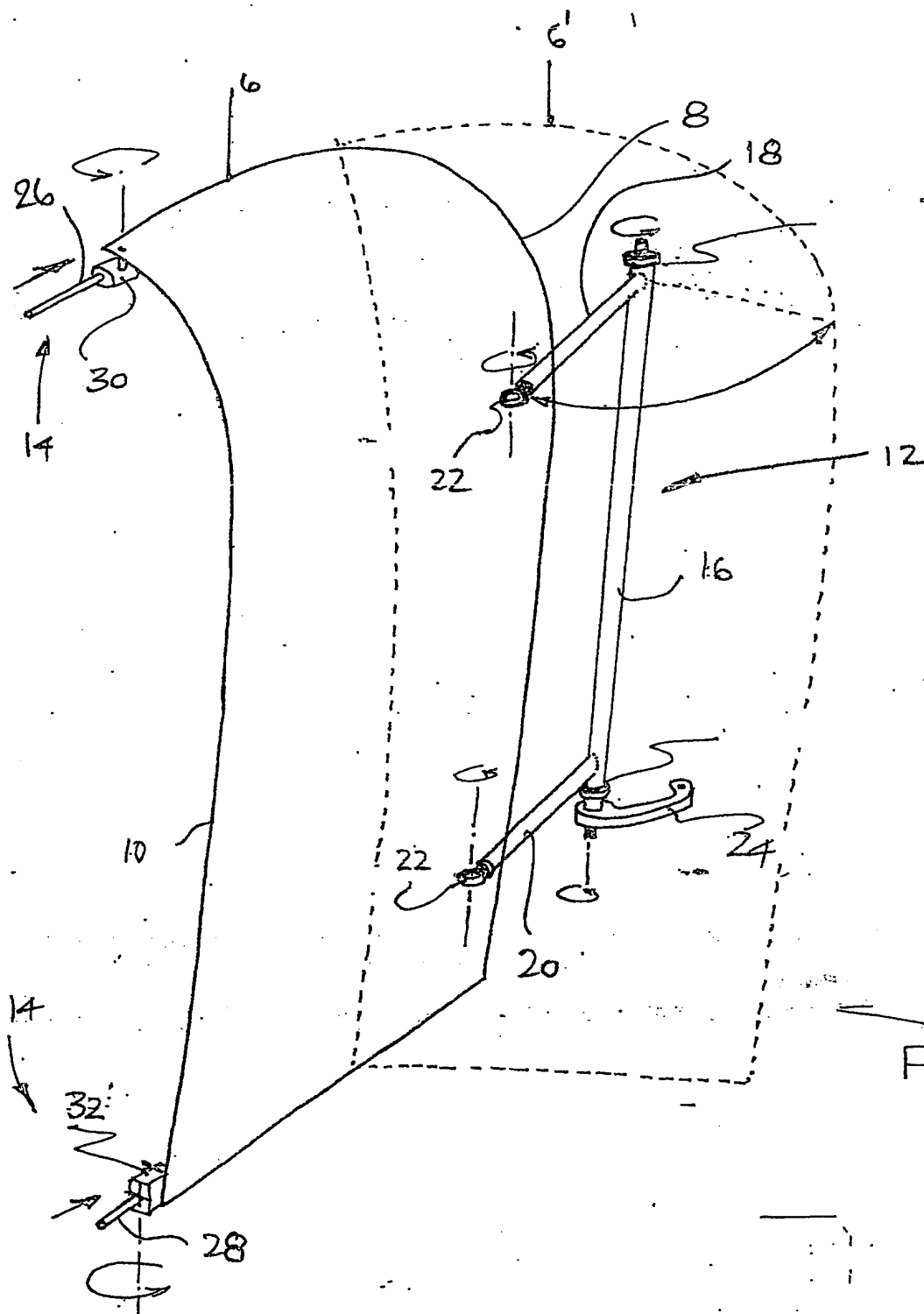


FIG. 3

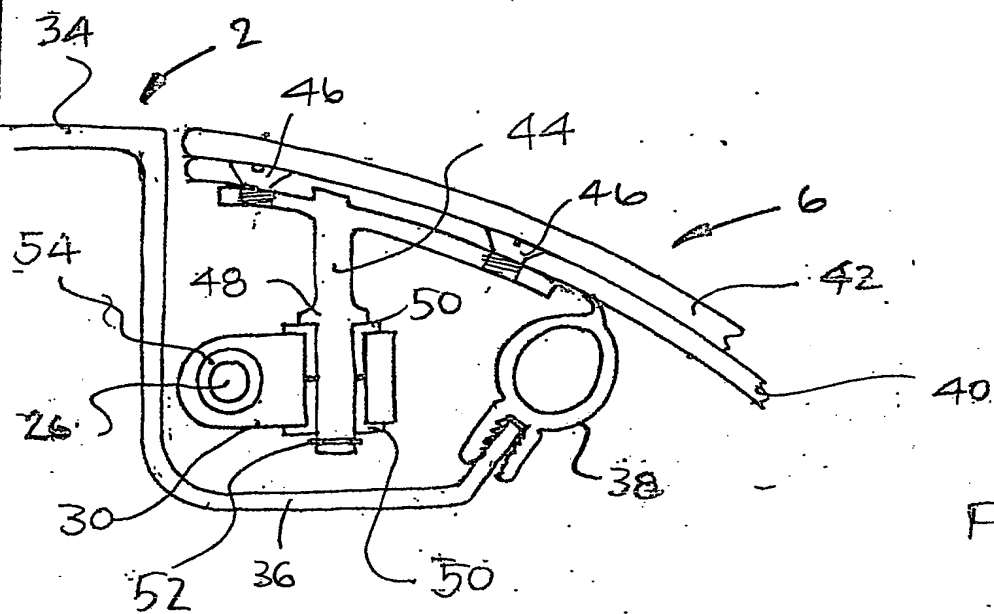


FIG. 4

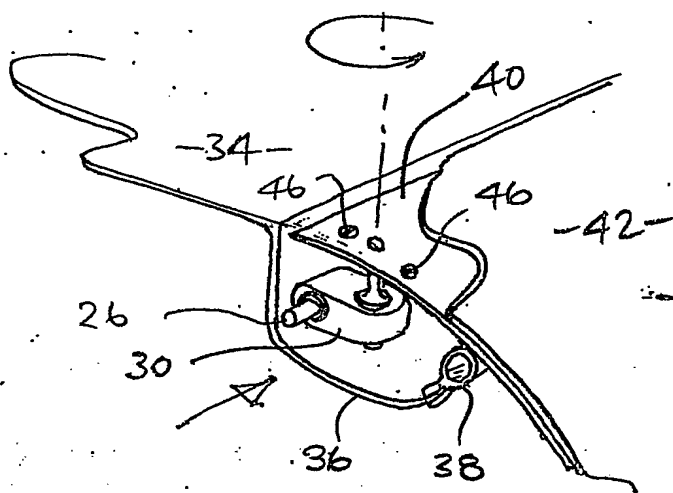
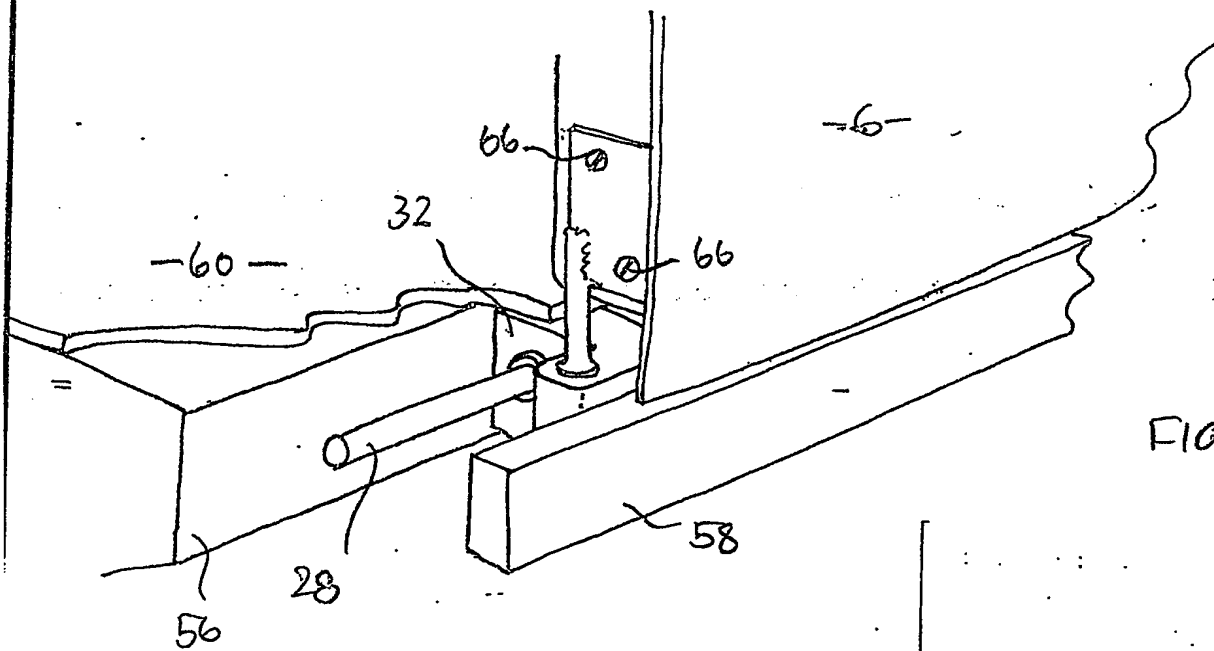
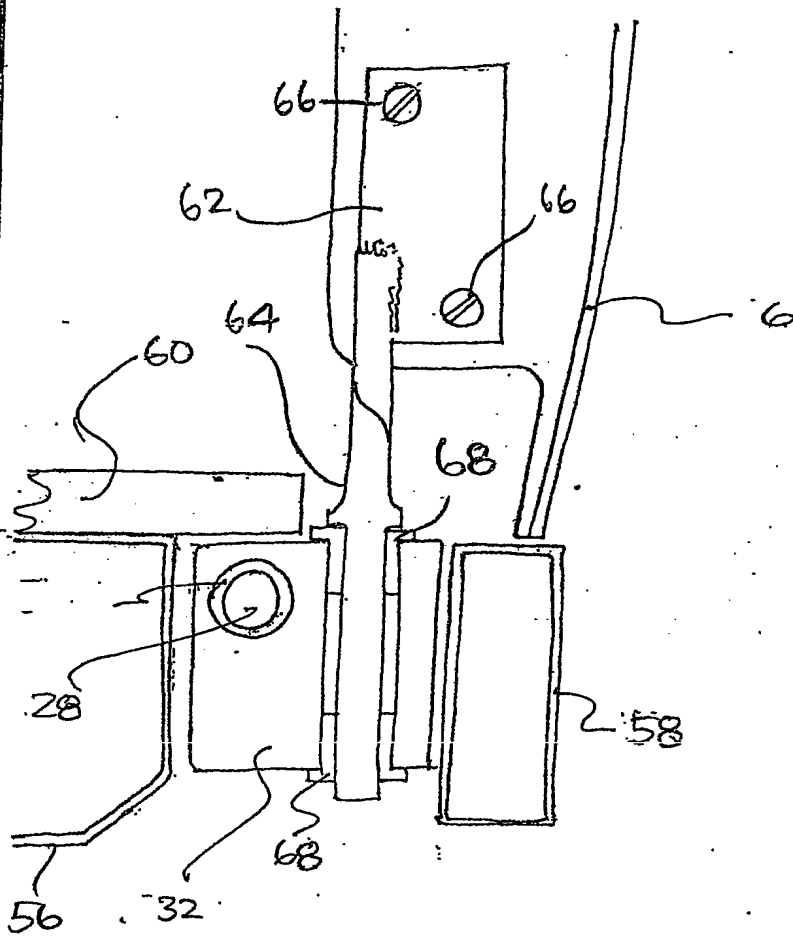


FIG. 5



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